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The Economic Impact of Export Controls

An Application to Mongolian Cashmere and Romanian Wood Products

Wendy E. Takacs

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Summary findings

Countries sometimes use export controls on raw materials to encourage domestic processing. The motivation is usually to assure raw materials at low prices for domestic industries, although exports are sometimes controlled in an attempt to increase export earnings (by promoting exports of higher value-added processed goods rather than raw materials).

The problem is, export controls hurt raw material producers and cause economic distortions that result in net losses to the country. The impact of raw material export controls on total export earnings is ambiguous: the decline in raw material exports when production is discouraged by lower prices may outweigh the effect of increased exports of processed goods.

Takacs develops a simple partial equilibrium model of export controls on raw materials to investigate the impact of export restrictions and to estimate the potential magnitude of the transfers between groups and the net costs of the export-control regimes.

Her estimates of the magnitude of transfers and costs of export controls on raw cashmere (in Mongolia) and wood products (in Romania) indicate that the transfers and costs may be substantial.

She finds that (under reasonable assumptions about elasticities of supply) export controls can transfer significant profits from the raw materials producers to the processing industries, causing significant net losses to the economy and a substantial net decrease in export earnings.

Quantitative export controls will be even more distortive if processing industries have any monopsony (single-buyer) power. This is quite likely in developing countries with small industrial bases — or in economies in transition, where central planning has left a legacy of very large firms in highly concentrated industries.

With monopsony power in the processing industry, both output and exports of final products can be reduce by quantitative export controls on raw material inputs. The quantitative control bestows effective monopsony power on the processing firm and encourages it to exploit this monopsony power by reducing output. If the raw materials could be freely exported, processors would not be able to effectively exercise monopsony power.

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The Economic Impact of Export Controls: An Application to Mongolian Cashmere and Romanian Wood Products

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I. Introduction

Export controls on raw materials have been used by countries to encourage domestic processing activities.[2] Such controls can take the form of complete prohibitions on exports, export quotas, export licensing requirements, or export taxes. They are usually motivated by a desire to assure raw materials at low prices for domestic processing industries, but other stated purposes include preventing exporters from selling without a letter of credit from the importer or selling at prices considered too low. Export controls on raw materials are also justified as a method of increasing export earnings by promoting exports of higher value-added goods rather than raw materials.

Export controls on raw material or intermediate inputs increase the effective rate of protection to the processing industries by lowering input costs. But they create costly distortions and efficiency losses and they benefit owners of processing facilities at the expense of raw materials producers. The purpose of this paper is to develop a simple partial equilibrium model of export controls on raw materials to investigate the impact of the restrictions and generate rough estimates of the potential magnitude of the transfers between groups and net costs of the regimes. Section II develops a model that links the markets for material inputs and final goods under the assumption of competitive markets for inputs and outputs, indicates the nature of the transfers and net costs generated by export restrictions on inputs, and indicates a method for calculating estimates of the size of the transfers and costs. Section III applies the model to two case studies: export licensing requirements for raw cashmere in Mongolia and export prohibitions and quotas for wood products in Romania. Section IV then extends the analysis to a monopsonistic market structure in the final goods industry. A monopsonistic processor of raw materials may be a relevant market structure for developing countries that lack a broad industrial base and for transitional economies in which central planning led to high industry concentration, and thus a single processor or small number of buyers of certain raw material inputs.

II. Raw material export controls with perfectly competitive markets

Suppose that a raw material input, I (such as raw cashmere) is used as in input into the production of a final product, F (such as cashmere sweaters). Suppose also that the country under consideration is small, so that it cannot influence the price of either the raw material or the final product in world markets.[3] To ease graphical presentation and link the markets for inputs and outputs, define units of input so that one unit of input is required to produce one unit of output.[4] The perfectly competitive processing industry is willing to process more inputs into output the higher the value-added per unit in processing:

$$Q_F^S = S\,(P_F - P_I) \tag{1}$$

where Q_F^S is the quantity of final product supplied, P_F is the price of the final good, P_I is the price of the raw material input and $P_F - P_I$ is the value-added per unit.

Suppose that demand for the final good within the country depends upon the price: [5]

$$Q_F^D = D\,(P_F) \tag{2}$$

Net exports of the finished product will be the difference between the quantity supplied and the quantity demanded:

$$X_F = Q_F^S - Q_F^D \tag{3}$$

Suppose that the raw material is produced by a perfectly competitive input industry and that the quantity of the raw material input supplied depends on its price:

$$Q_I^S = S_I\,(P_I) \tag{4}$$

Suppose that the raw material is not demanded in the domestic market except as an input to

the final goods processing industry. This assumption, along with the definition of the "units" of input, implies that:

$$Q_I^D = Q_F^S \tag{5}$$

Exports of the raw material will be the difference between the quantity supplied and the quantity demanded as inputs by the domestic industry:

$$X_I = Q_I^S - Q_I^D = S_I(P_I) - Q_I^D(P_F - P_I) \tag{6}$$

The equilibrium in this model under free trade is shown in Figure 1. If there were no trade restrictions, the domestic prices of both the final good and the raw material would be equal to their prevailing world market price. The supply curve of processing as a function of the value-added is shown in the upper panel of Figure 1 by the curve S(V). The height of the curve is the value-added per unit of final good produced, V. The processing industry's supply curve of the final product under free trade, S_F^*, would lie above S(V) by the raw material input costs per unit, P_I^W. The demand curve for the product is D_F. The upper panel of figure 1 shows the market equilibrium for the final product under free trade. If the world market price of the final good were P_F^W, the world market price of the input were P_I^W, and there were no trade restrictions, the quantity demanded would be D_F^*, the quantity supplied by the processing industry would be Q_F^*, and Q_F^*-D_F^* (= X_F^*) would be exported.

The market for the raw material is shown in the lower panel of figure 1. The units along the horizontal axis measure the quantity of "packages" of inputs, where each "package" represents the inputs needed for one unit of output. The price measured along the vertical axis is likewise the price per "package" of inputs. The domestic raw materials industry supply curve is shown by S_I. If the price of the raw material in the world market were P_I^W, the domestic raw materials industry would

produce an output Q_I^*. At this price of the raw material, the domestic final goods processing industry supply curve would be S_F^*, the output of final goods would be Q_F^*, and the demand for raw materials on the part of the domestic processing industry would be D_I^*. The quantity exported would be X_I^* ($=Q_I^*-D_I^*$). Export earnings from final goods exports would be $P_F^W X_F^*$ and export earnings for raw materials exports would be $P_I^W X_I^*$.

Suppose that the government now controls exports of the raw material by imposing an export quota that allows no more than a maximum amount to be exported[6]. Suppose this system is enforced through an export licensing system. In terms of the model, the domestic price of the raw material will no longer necessarily equal the world market price because producers are not free to export. A binding quota restriction implies that the quantity of exports is given, and the domestic price of the raw material input would be determined by equation (6) as the price at which the difference between the quantity of raw material supplied and the quantity demanded would equal the maximum amount allowed to be exported.

Given that the quantity demanded depends upon the output of the processing industry, and given that the position of the processing industry supply curve depends upon the price of the raw material, the new equilibrium would be determined jointly in both markets. As the raw material input price falls due to the export restriction, input costs of the processing industry fall and the processing industry supply curve shifts downward, or to the right. At a constant final product price, output of the final product (and therefore the quantity of the raw material demanded by the processing industry) increases. Figure 2 illustrates the new equilibrium after an export restriction limiting raw material exports to X_I' is imposed. The price of the input will settle at P_I^D, where the quantity demanded (equal to the quantity of final good supplied at the world market price P_F^W and input price P_I^D plus X_I) equals the quantity of input supplied along S_I. The decline in the equilibrium raw material price

will reduce raw material production from Q_I^* to Q_I'. In the final goods market, output increases from Q_F^* to Q_F'.

The raw material export restriction hurts producers of the raw material and discourages raw material production and exports, but increases profits of the processing industry, as well as production and exports of the final good. The gains to the processing industry and the losses to the raw material producers, as well as the net efficiency losses from the restriction, can be identified and estimated. In the market for raw materials, producer profits fall because of falling prices. The loss in profits is usually identified as a loss in "producer surplus" equal to area adge in the lower panel of figure 2. The height of the raw material supply curve shows the marginal cost of producing each extra unit. When price falls to P_I^D, revenues decrease by area adrsge but costs decrease by only gdrc, so net income declines by area adge. Part of this loss (area abfe=area hijk) consists of a transfer from raw materials producers to the processing industry in the form of higher profits due to lower input costs. Another part (area bcgf) represents a transfer from raw materials producers to the recipients of export licenses, who are able to buy the raw material on the domestic market at P_I^D and sell abroad at P_I^W. The remainder (area cdg) is an efficiency loss because the extra units of raw material Q_I^*-Q_I', which would have been exported to earn P_I^W in the absence of the export restriction, would only have cost an amount equal to the height of the supply curve to produce. With the export restriction, these extra units of the raw material will not be produced and sold abroad for more than the cost of producing them. Area cdg thus represents a net efficiency loss to the country.

These transfers and efficiency losses can in principle be measured. The loss to producers of the raw material equals area adge:

$$
\begin{aligned}
\text{Area adge} &= dP_I\, Q_I + \frac{1}{2}\, dQ_I\, dP_I \\
&= dP_I\, Q_I + \frac{1}{2}\, \epsilon_I^s \frac{Q_I}{P_I}\, dP_I\, dP_I \\
&= dP_I\, Q_I \left(1 + \frac{1}{2}\, \epsilon_I^s \frac{dP_I}{P_I}\right) \\
&= V_I \frac{dP_I}{P_I}\left(1 + \frac{1}{2}\, \epsilon_I^s \frac{dP_I}{P_I}\right) \\
&= \pi V_I + \frac{1}{2}\pi^2 \epsilon_I^s V_I
\end{aligned}
\tag{7}
$$

where $\epsilon_I^S = (dQ_I/dP_I)(P_I/Q_I)$ is the elasticity of supply of the raw material, $V_I = P_I Q_I$ is the value of raw material production, $dP_I = (P_I^W - P_I^D)$, $dQ_I = (Q_I^* - Q_I')$, and $\pi = dP_I/P_I$. The efficiency loss area cdg will be equal to the last term of equation (7).

The part of the loss to raw material producers that is transferred to export license recipients is area bcgf:

$$
\begin{aligned}
\text{Area bcgf} &= dP_I\, X_I \\
&= \pi\, V_I^X
\end{aligned}
\tag{8}
$$

where V_I^X is the value of raw material exports.

In the market for the processed good, the processing industry gains area hikl. The industry marginal cost curve shifts downward from S_F^* to S_F' which reduces costs for each unit previously produced and therefore increases profits by area hnkl. Profits also increase by the difference between revenue and costs for the extra units produced, area nik. From the point of view of the country, however, the increase in domestic processing of the raw material creates an efficiency loss equal to area min because the artificially low raw materials price encourages the processing industry to expand output beyond the point at which the price in the world market equals the true cost of producing the final good, including the opportunity costs of exporting the raw material. Since S_F^* is parallel to S_F', but lies below it by $(P_I^W - P_I^D)$, area min = area ijk. This part of the transfer from the raw

material producers is not a gain to the processing industry, but is simply lost due to higher processing costs.

Again, these transfers and costs can be measured. The gain to the processing industry is area hikl:

$$\begin{aligned} \text{Area } hikl &= Q_F\, dP_I - \frac{1}{2}\, dQ_F\, dP_I \\ &= P_I Q_F\, d\frac{P_I}{P_I} - \frac{1}{2}\, \epsilon_F^S\, \frac{P_F Q_F}{V}\, \frac{P_I}{P_F}\, P_I \frac{dP_I}{P_I}\, \frac{dP_I}{P_I} \\ &= \phi V_F \pi - \frac{1}{2}\, \epsilon_F^S\, V_F \pi^2 \frac{\phi^2}{1-\phi} \end{aligned} \tag{9}$$

where v is the value-added per unit of final product, $\epsilon_F^S = (dQ_F^S/dv)(v/Q_F^S)$ is the elasticity of supply of processing with respect to the value-added per unit, $dQ_F=(Q_F'-Q_F^*)$, $\phi=P_I/P_F$ is the ratio of raw material cost to the price of the final product, and $V_F = P_F Q_F$ is the value of final good produced. Note that with the final product price unchanged, $dv=-dP_I$. The efficiency loss due to higher-cost domestic processing (area ijk) equals the second term in equation 9. If information on prices and quantities of inputs and outputs are available, the second step in equation 9 can be used for calculations, but the last step is more suitable when the only information available is from an input-output table for the economy.

The welfare impact and net efficiency losses are the appropriate criteria for judging the beneficial or detrimental effects of the export restrictions. But so much emphasis has been placed on using raw material export controls to encourage higher-value-added exports and therefore export earnings that we investigate in detail the impact of the raw material export controls on total export revenue. Foreign exchange earnings from final goods exports increase by $P_F^W(Q_F'-Q_F^*)$. Raw material exports fall from X_I^* to X_I', and export earnings fall by $P_I^W(X_I^*-X_I')$. Export earnings from exports of final goods increase, but earnings from raw material exports decrease because the quantity

exported decreases by the amount diverted to the domestic industry, $D_I'-D_I^*$ ($=Q_F'-Q_F^*$), plus the decrease in production $Q_I^*-Q_I'$ due to the lower raw material price. The net impact of the raw material export restriction on total export earnings is ambiguous.

The change in total export earnings due to the export control on raw materials would be the difference between the increase in the value of final good exports and the decrease in the value of raw material exports. Given that $X_I=Q_I^S-Q_I^D$ and $dQ_I^D = dQ_F^S$, the change the value of raw material exports would be:

$$\begin{aligned} d[P_I^W X_I] &= P_I^W[dQ_I^S - dQ_I^D] \\ &= P_I^W\left[\epsilon_I^S Q_I \frac{dP_I}{P_I} - \epsilon_F^S \frac{P_F Q_F}{V}\frac{P_I}{P_F}\,dv\right] \\ &= P_I^W\left[\epsilon_I^S Q_I \frac{dP_I}{P_I} + \epsilon_F^S V_F \frac{1}{P_F}\frac{\phi}{1-\phi}\frac{dP_I}{P_I}\right] \\ &= (1+\pi)\epsilon_I^S V_I \pi + \epsilon_F^S V_F \frac{\phi^2}{1-\phi}(1+\pi)\pi \end{aligned} \tag{10}$$

The first term captures the decline in raw material exports due to the fall in production; the second captures the decline in exports due to the diversion to domestic processing.

Holding domestic demand for the final good constant, and allowing for free exportation of the processed good at an unchanged world market price, the export restriction on raw materials would increase exports of the final good.[7] The magnitude of the increase in processed good export earnings would be:

$$\begin{aligned} P_F^W\, dX_F &= P_F^W\, \epsilon_F^S \frac{Q_F}{V}\, dP_I \\ &= P_F^W Q_F \epsilon_F^S \frac{P_I}{V}\frac{dP_I}{P_I} \\ &= V_F \epsilon_F^S \frac{\phi}{1-\phi}\pi \end{aligned} \tag{11}$$

Therefore total export earnings would change by:

$$dV^x = V_p \epsilon_P^g \frac{\phi}{1-\phi}\pi - [(1+\pi)\epsilon_I^g V_I \pi + \epsilon_P^g V_p (\frac{\phi^2}{1-\phi})(1+\pi)\pi]$$
$$= V_p \epsilon_P^g \frac{\phi}{1-\phi}\pi [1-(1+\pi)\phi] - \pi(1+\pi)\epsilon_I^g V_I \qquad (12)$$

Total export earnings will increase if equation (12) is positive but decrease if it is negative.

The raw material export control is more likely to increase export earnings the greater the value-added in processing (the smaller is ϕ), the greater the elasticity of supply of the processing industry, and the smaller the elasticity of supply of the raw material, and the larger the processing industry relative to raw material production.

III. Application to Mongolian Cashmere and Romanian Wood Export Controls

This section applies the model in an attempt to quantify the impacts of two examples of export controls on raw materials: the export licensing requirements for raw cashmere in Mongolia and the export prohibitions and quotas on timber and other basic lumber products in Romania.

Mongolia has imposed export licensing requirements on a number of raw materials. As of August, 1992, these included live animals, wool, raw cashmere, camel wool, sheepskin, goatskin, and timber.[8] Sufficient data were available to apply the model to raw cashmere. The values of the variables that were used in equations 7 through 12 to calculate the magnitude of the transfers and net costs associated with the export licensing arrangements, along with an explanation of the sources, appear in Table 1.

The gains, losses, and net costs were estimated assuming varying degrees of responsiveness of both raw material and final good production to changes in prices. The calculations presented use

combinations of elasticity ranges of from 0.5 to 1 for raw cashmere and 1 to 3 for garment production.[9] The results appear in Table 2. Of particular note is the result that the export controls on raw cashmere appear to reduce total export earnings.[10]

Also noteworthy is the magnitude of the transfers. Because a large amount of raw cashmere is exported, the impact of even the modest 16.6 percent price differential between the world market and domestic price imposes large losses on herdsmen and allows large gains to those able to export. The estimated losses of $5.5 to $7 million dollars would represent $5 to $7 per person to the approximately 1 million people in the countryside. The rents generated from exporting are about $4 million.

As of March, 1993, Romania imposed export prohibitions or quotas on a relatively large number of raw material and intermediate inputs. These included wood products that are inputs into the furniture industry, starting with logs, timber and firewood, up through lumber, plywood, particle board, and veneer.[11]

Data on quantities and values of production and exports of all the various products were not available, but the 1990 Romanian input-output table separately identifies the woodworking and furniture industries. Estimates of the impact of the export controls were based on the input-output table, under the assumption that the woodworking sector represented production of inputs used in the furniture sector. Equations 7 through 12 were used to calculate estimates of the magnitude of the transfers and net costs associated with these export restrictions. The values for the variables in those equations, and an explanation of the sources and reasoning behind them, appear in Table 3. The resulting estimated impacts of the wood products export controls appear in Table 4.

Romania currently imposes restrictions on cutting of timber to protect the environment and allow rebuilding of the timber stock. These restrictions can be interpreted as implying a zero elasticity of supply of timber (and therefore wood products) in the short run. However, in the long

run additional planting and harvesting of timber would be possible, so estimates are presented using both a short-run scenario, in which the elasticity of supply of raw material inputs is assumed equal to zero, and the elasticity of supply of value-added in furniture production is assumed equal to one, and alternative long-run scenarios, in which the elasticity of supply of raw material input is assumed to be positive. To illustrate the sensitivity of the results to assumptions about the elasticities of supply of wood product material inputs and furniture, the results of two alternative "long-run" scenarios are presented, one assuming that both elasticities of supply equal one, and a second assuming a low elasticity of supply of wood products of 0.5, but a higher elasticity of supply of furniture production of 5.

The results indicate that the export controls on wood may impose severe losses on the wood input industries. The estimated decreases in profits range from about 8 to 10 billion lei per year. If there is a nonzero elasticity of supply of wood, there are also efficiency losses in the wood market, estimated here between 1 and 2 billion lei per year. The gain in terms of increased profitability of the furniture industry is about 1.5 to 2.3 billion lei, while the estimated efficiency losses from increased furniture production amount to 200 million to approximately 1 billion lei. The result of the wood inputs export controls are ambiguous and depend crucially on the elasticities of supply in the two industries. In the short-run scenario in which wood inputs production cannot respond to price changes, the export controls increase total export earnings by approximately 2 billion lei. However, in the first long-run scenario, assuming equal elasticities of supply of wood products and furniture, the discouraging effect of the export controls on wood production and the diversion of wood exports to furniture production decreases wood input exports by almost 14 billion lei, while furniture exports increase by a much smaller amount. The net result is a decrease in total export earnings from wood products and furniture of over 10 billion lei.

Raw material export controls with monopsonistic processor

The analysis so far has assumed that the markets for both inputs and outputs are competitive, that is, contain a large number of both buyers and sellers. In many cases of raw material export controls, the assumption of a large number of producers of the raw material may not diverge too much from reality, but in many cases there may be one or only a few processors, which creates a monopsonistic (single buyer) market structure in the raw material market. Whether a monopsony is able to exercise monopsony power depends crucially on the international trade policy in effect. If the raw materials processed by these firms can be freely exported, then these processors may not be able to effectively exercise monopsony power. They will have to compete with potential exporters of the raw materials and will be forced to pay the world market prices for their inputs. On the other hand, if the inputs cannot be exported or if exports are limited to predetermined quantities, then the processors will be able to control the price of the raw materials through their purchasing decisions. A relevant question may very well be whether a monopsonistic market structure changes any of the basic conclusions above with respect to the impact of export controls of the raw material.

The determination of prices, production, and exports of raw materials and processed products in the case of a monopsonistic market structure in the absence of any export restriction is illustrated in Figure 3. As in the previous figures, the upper panel represents the market and production conditions for the final product and the lower panel the market and supply conditions for the raw material input. In the upper panel D represents the demand curve for the final product and MC(V) represents the marginal cost for factors of production other than the raw material input. The extra cost of an extra "unit" of raw material input must be added vertically to MC(V) to obtain the marginal cost of production curve MC. If the world market price of the input is P_I^W, and exporters are free to export at this price, the processor will also have to pay P_I^W, and the marginal cost curve for the processor will be MC as shown in the upper panel of figure 3. If the world market price of

the final product is P_F^W, then the processor would maximize profits by producing at an output level of Q_F^*.[12] The quantity of the final good exported would be X_F^* the difference between Q_F^* and D_F^*. The value of export earnings from final product exports would be the area abcd in figure 3.

In the input market, the processor would demand D_I^* units of input, the producers would supply Q_I^* at the price P_I^W, so the quantity exported would be X_I^* ($=Q_I^*-D_I^*$). Earnings from exports of the raw material would be $P_I^W X_I^*$, equal to area efgh.

Compare this outcome with the resulting prices, production and export earnings if exports of the raw material are limited by some form of quantitative export restriction, such as a restrictive licensing system, an export quota, or an export ban or embargo. The analysis is developed in the form of an export ban because it is the simplest to illustrate and Mongolia has banned exports of certain raw materials at times in the past. The results would be similar with other forms of quantitative export restrictions.[13]

A ban on exports of the raw material input implies that the single processor faces the upward sloping supply curve of the raw material input S_I. The greater the output of the processor, the more raw material purchased, and the higher the resulting market price of the raw material. Because the processor would drive up the market price for all unit of the inputs used, not just the last unit bought, the extra cost of an extra unit of input to the processor will exceed the market price. A curve showing the extra cost of extra units of input, labeled MC_I in the lower panel of Figure 4, can be derived from the input supply curve S_I.[14] After the restriction on the exportation of the input, the marginal cost of the final good would be MC'. It is derived by adding MC_I to MC(V). The monopsonistic processor can still sell in the world market at P_F^W, so the processor's profits would be maximized at Q_F', the output level at which the world market price equals the marginal cost of production. In the case illustrated in Figure 4, this would be at a lower output level than without the export ban. The processor reduces output because lowering output reduces the demand for the input

and reduces his cost for the raw material inputs. As shown in figure 4, when only one profit maximizing processor buys a raw material on the domestic market, an export ban on the raw material eliminates exports of the raw material, and can decrease production and exports of the final good. In this case, total export earnings from both the final product and the raw material must decrease. Figure 4 illustrates the case in which total export earnings fall, but this result is not unambiguous. If exports of the raw material are large relative to production of the final good, output and exports of the final good may increase.[15]

As in the competitive industry case analyzed first in this appendix, the export ban will reduce real income or profits of the raw material producers and increase the profits of the processing industry. Revenues of the raw material producers fall from efgh to ijkh. Revenue from raw material exports will fall by lfgk. Of this reduction in export revenue, lfj represents a net loss to the country because it is the difference between export revenues lost and the incremental cost of producing the quantity that would have been exported in the absence of the export ban. Area elji represents a transfer from raw materials producers to the processing firm.

CONCLUSIONS

Export controls on raw materials reduce raw material prices to domestic processing industries and encourage domestic processing, but hurt raw material producers and cause economic distortions that result in net losses to the country. Exports of raw materials are sometimes controlled in an attempt to increase export earnings by promoting exports of higher value-added processed goods rather than raw materials. However, the impact of raw material export controls on total export earnings is ambiguous; the decline in raw material exports when production is discouraged by lower prices may outweigh the effect of increased processed goods exports.

Estimates of the magnitude of the transfers and costs of export controls on raw cashmere in

Mongolia and wood products in Romania indicate that the transfers and costs involved may be substantial. These estimates are designed to be illustrative rather than definitive, because no estimates of actual supply elasticities in the raw material and processing industries in these countries are available, so the estimates are based on a range of assumed values for these elasticities. Despite these caveats the calculations do indicate that in both these cases the export controls, under reasonable assumptions of elasticities of supply, may transfer significant amounts of profits from the raw material producers to the processing industries, cause significant net losses, and result in a substantial decrease in export earnings.

The impact of quantitative controls on exports will be even more distortive if processing industries have some degree of monopsony power, which is quite likely in developing countries with small industrial bases, or economies in transition where central planning has left a legacy of very large firms in highly concentrated industries. With monopsony power in the processing industry, both output and exports of final products may be reduced by quantitative export controls on raw material inputs, because the quantitative control bestows effective monopsony power on the processing firm and encourages it to exploit this monopsony power by reducing output.

ENDNOTES

1. This paper is based on research for the UNDP/World Bank Trade Expansion Program reports for Mongolia and Romania. The author thanks Jaime de Melo and Arvind Panagariya for useful comments on a previous draft. The views are those of the author, not necessarily those of the United Nations or of the World Bank.

2. In England Elizabeth I banned the exportation of wool fleeces in the 16th century to encourage the textile industry. Other modern examples include Uruguayan prohibitions on exports of raw hides. Many countries currently undertaking the transition from central planning to a market economy also control raw material exports.

3. For Romanian wood products this assumption is reasonable. In the case of cashmere, however, Mongolia may have the ability to influence world market prices. Published estimates of Mongolia's share of world raw cashmere production range between 10 percent (Browne, 1990) and 20-25 percent (Economist Intelligence Unit, 1991). Mongolia exports both raw cashmere and knitted cashmere products, so higher world market prices for raw cashmere increase export earnings directly and also indirectly by increasing the costs of competing firms in the market for knitted cashmere products. For an analysis of the potential welfare gains from exploiting market power in world raw material markets when a country also exports the final product, see Jones and Spencer (1989). Including market power in world markets in the model would be a useful extension of this paper.

4. This approach is based on Corden (1973, pp. 30-35). Suppose that the processing industry uses α inputs to produce one unit of output. Then each "package" of α inputs would be a "unit" of inputs. For example, if 10 ounces of raw cashmere were used to produce a sweater, then a 10-ounce ball of raw cashmere would be one "unit" of input. If the price of an ounce of cashmere were $1.00, then the price of a "unit" of input would $10.00.

5. Income is omitted as a determinant of demand because of the partial equilibrium assumption.

6. The limit case of a complete ban on exports of the raw material would be analyzed as a zero quota.

7. The increase in exports may be underestimated in the partial equilibrium framework used here if income feedback effects are important. Lower real incomes due to the efficiency losses could reduce domestic demand for cashmere products, which are presumably luxury goods. On the other hand, lower income may reduce imports and therefore exports through balance of payments or exchange rate effects.

8. This list is based on information from the License Bureau, Ministry of Trade and Industry. Exports of other products also were subject to license: scrap copper, scrap iron, scrap aluminum, scrap aluminum alloy, scrap steel, meat, wheat, children's clothes and shoes, and imported

9. Elasticities of supply of processing with respect to value-added of up to 10 were tried, but elasticities of over 3.4 resulted in such large estimated impacts on processing that output would have become negative in the absence of the export controls. The large impact on processing stems in part from the high ratio of the price of raw cashmere input relative to the price of finished garments. Raw cashmere cost is over half the price of the finished garment, so a drop in the price of raw cashmere at constant final good prices represents a larger percentage increase in the value-added per unit.

10. With a small elasticity of supply of raw material and a large elasticity of supply of processing ($\epsilon_I^S=0.5;\epsilon_P^S=10$), export earnings increased by a relatively modest \$80,608, achieved at an estimated cost of \$718,186 in deadweight efficiency losses. This case is not reported because the estimates at these high elasticity levels indicated that output would decrease so much that it would become negative, which would result in nonsensical calculations of transfers.

11. Order No. 120 of 31 July 1992 prohibited the export of logs, rafters, lumber, railway sleepers, Christmas fir trees, firewood, wood for cellulose, fiberboard, timber, wooden pallets and veneers, and imposed the following quotas:

Product	Quantity
Beech-tree plywood	50,000 m^3
Panels	1,300,000 m^2
Beech-tree parquet	500,000 m^2
Chipboard	800,000 m^2
Timber and semifabs of resinous woods, beech and softwoods	300,000 m^2
Door and windowframes	1,000,000 m^2

12. This analysis presumes that the behavior of the processing firm is to attempt to maximize profits. In a transitional economy such as Mongolia, it is not clear what the objective of firms that are still state-owned actually is. As these firms become privatized and thus presumably responsive to the shareholders' desire for high dividends or growth in share value, firms will presumably shift their objectives to profit maximization.

13. It is important to note that discouraging exports through an export tax will not give the monopsonistic processor control over the domestic market price. The export tax will lower the input price, but exporters will still be free to export as long as they pay the tax, so price will fall no lower than the world market price minus the tax. The export tax system will also yield revenue for the government, rather than profits in the form of quota rents to exporters who are able to obtain licenses.

14. The marginal cost curve of the input will lie half-way between the supply curve S_I and the vertical price axis. See Ferguson and Maurice (1979) or virtually any other intermediate level microeconomic theory textbook for an explanation of the analysis of monopsony .

15. MC' must cross MC at the output level at which MC_I crossed a horizontal line of height P_I^W. This point (shown as point a) lies to the left of Q_F^* in the case shown in figure A.4.4). Because MC' must be steeper than MC, the quantity produced by the processor (and therefore the quantity exported with unchanged demand condition) must be lower. If the supply curve had been much further to the right (passing through b, for example) then MC_I would have passed through point c, MC' would have crossed MC at point d with a steeper slope, and output and exports of the final good could increase. In this case the value of the extra exports of final good would have to be balanced with the elimination of exports of the raw material to determine whether total export earnings decrease or increase. Large exports of the raw material relative to domestic production of the final good increases the probability that there will be an increase in output because point a will be at a larger output level.

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Table 1

Variables Used in Calculations of the Impact of Mongolian Cashmere Export Licensing Requirements

P_I^W	$25.89/"package"	Data provided by the large Gobi factory indicate that the factory took in 900 tons of raw cashmere, approximately 450 tons of which was exported as greasy or dehaired cashmere, approximately 80 tons processed for export as tops, and the remaining 370 tons used to produce garments. This would imply that 370,000 kilos of unprocessed cashmere was processed into 250,300 garments. The "package" of unprocessed cashmere input per piece produced, on average, would be 1.48 kilos. The unit value of unprocessed cashmere exports in 1992 was $17.49/kilo: 1657.53 metric tons valued at US$28,986,430 (Ministry of Trade and Industry). Thus the world market price of a "package" of input would be US$25.89.
P_F^W	$35.05/piece	Unit value of exports of cashmere garments in 1992: 142,190 pullovers were exported valued at US$7,664,460; US$341,970 of "other garments" were exported, but no quantity figures were available. Data provided by the large Gobi factory indicated that they had produced approximately 95,800 other garments in 1992, and approximately 90 percent of their output is exported. This would imply exports of 86,220 other garments. Thus an estimated 228,410 garments were exported valued at US$8,006,430
X_I	1,119,953	Exports of unprocessed cashmere in 1992 were 1,657,530 kilos, equivalent to 1,119,953 "packages" of inputs.
Q_F	275,300	Large Gobi factory output of approximately 250,300 pieces, plus estimated 25,000 of small Gobi factory.
Q_I	1,395,253	Raw material output measured in "packages" of inputs equals finished product production plus exports of raw material
dP_I	$3.69	Data provided by the Gobi factory indicate that the price of unprocessed cashmere in 1992 was 600 tugriks/kilo (at the official exchange rate of 40 tugrik/US$, $15.00/kilo) for unprocessed cashmere. This would imply a domestic price of $32.40 per "package" of input, $3.69 below the export price.
π	.166	Calculated as $dP_I/(P_I^W-dP_I)$
ϕ	0.633	Calculated as $(P_I^W-dP_I)/P_F^W$
$\epsilon_F^S, \epsilon_I^S$	0.5 to 3 [5]	Elasticities of supply of unprocessed cashmere and cashmere garments, respectively.

Table 2
Estimated Impact of Mongolian Cashmere Export Licensing Requirements
(US dollars)

Elasticity of supply of cashmere	0.5	1	0.5
Elasticity of supply of garments	1	1	3
Loss to cashmere producers	5,362,424	5,576,364	5,362,424
Efficiency loss in cashmere production	213,940	427,881	213,940
Gain to garments industry	870,000	870,000	578,287
Efficiency loss in garments production	145,857	145,857	437,570
Decline in raw material export	5,048,857	8,050,979	9,142,326
Increase in garments export earnings	2,770878	2,770,878	8,312,635
Change in total export earnings	-2,277,979	-5,280,101	-829,691
Transfer to export license recipients	4,132,627	4,132,627	4,132,627
Total efficiency loss	236,922	420,371	634,266
Increase in garments production (units)	79,055	79,055	237,165

Table 3

Data for Estimation of Impact of Romanian Wood Export Controls

V_I	16,959	Value of output of woodworking industry. (millions of lei) Data are from the 1990 Romanian input-output table for the woodworking sector (sector 32)
V_F	20,868	Value of furniture output (sector 77 of 1990 input-output table) (millions of lei)
V_I^X	230	Value of exports under quota of plywood, laminated board and chipboard, all potential inputs for the furniture industry (millions of lei)
ϕ	0.24	P_I/P_F, calculated from ratio of value of inputs of woodworking industry into the furniture industry to value of output of furniture industry from 1990 input-output table.
π	0.5	$(P_I^W-P_I)/P_I$, the percentage difference between the world and domestic price of raw material inputs due to the export controls on raw materials. A study of the Romanian wood-based industries by the Swedish consulting firm Jaakko Poyry (1992) estimated that the prices of wood material input costs for the furniture industry were far below the prices in other countries. Input costs were less than half the costs in the next-least expensive country, Poland. Costs of half the world market price would imply a cost differential as a percentage of the domestic price of 100%. Romanian critics of the Jaakko Poyry study argue that it overestimates the wood price differential, and that 50% would be a better estimate. The 50% figure is used here, but the estimates of the costs and transfers would be even larger than those calculated if the actual price differential is larger.
$\epsilon_F^S, \epsilon_I^S$	0 to 5	Assumed elasticities of supply

Table 4

Estimated Impact of Romanian Wood Export Controls

Millions of lei	Short run $\epsilon_I^S=0$ $\epsilon_F^S=1$	Long run $\epsilon_I^S=1$ $\epsilon_F^S=1$	Long run $\epsilon_I^S=0.5$ $\epsilon_F^S=5$
Loss to wood industries (area adge)	8,480	10,599	9,539
Efficiency loss in wood industries industry (area cdg)	0	2,120	1,060
Transfer to export license recipients (area bcgf)	115	115	115
Gain to furniture industry (area hikl)	2,306	2,306	1,516
Efficiency loss in furniture industry (area ijk)	198	198	988
Decline in wood exports	1,186	13,905	12,291
Increase in furniture exports	3,294	3,294	16,475
Change in total exports	2,108	-10,610	4,184

FIGURE 1:

Final good and raw materials markets: no trade restrictions

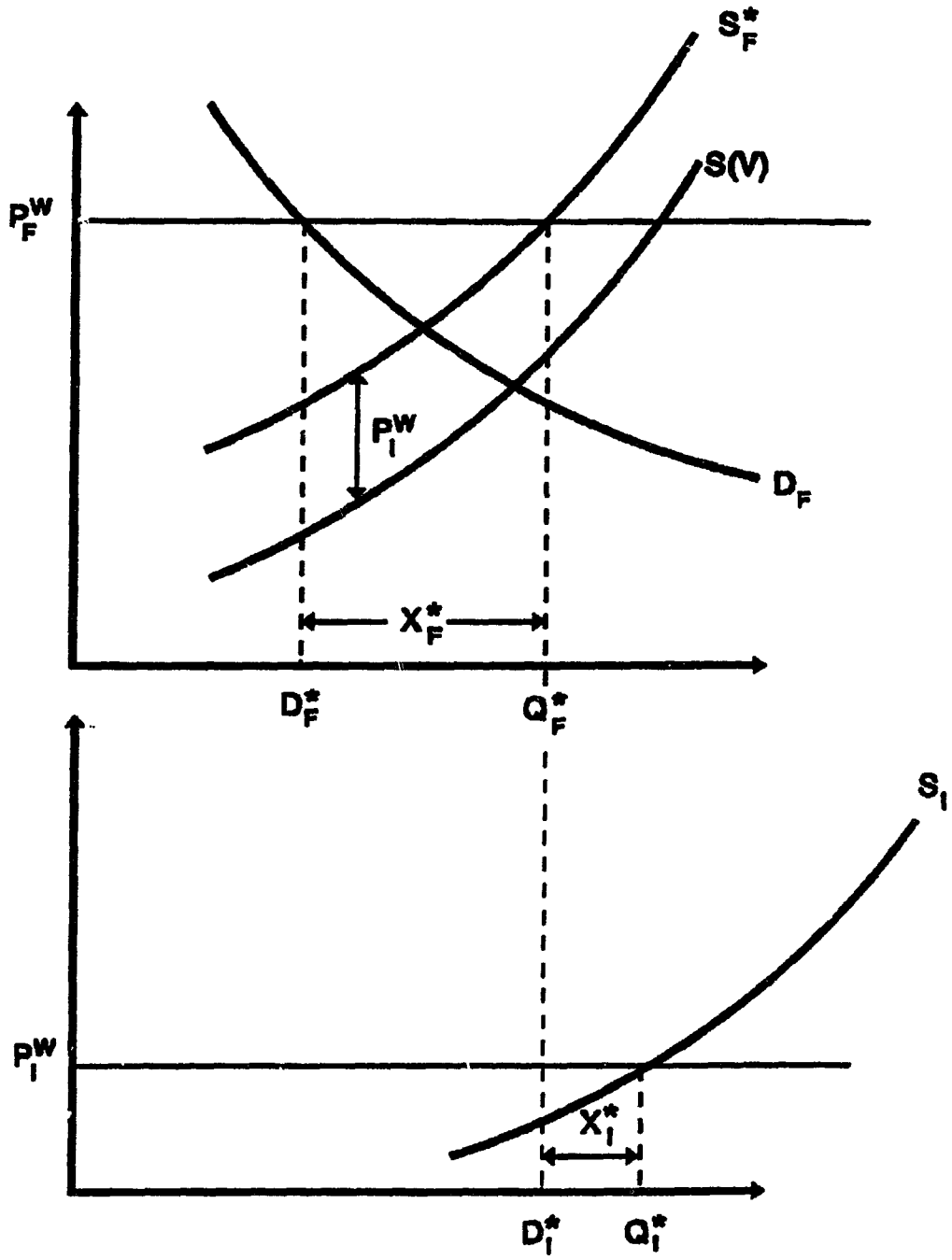


FIGURE 2:

Final good and raw materials markets' export control on raw material

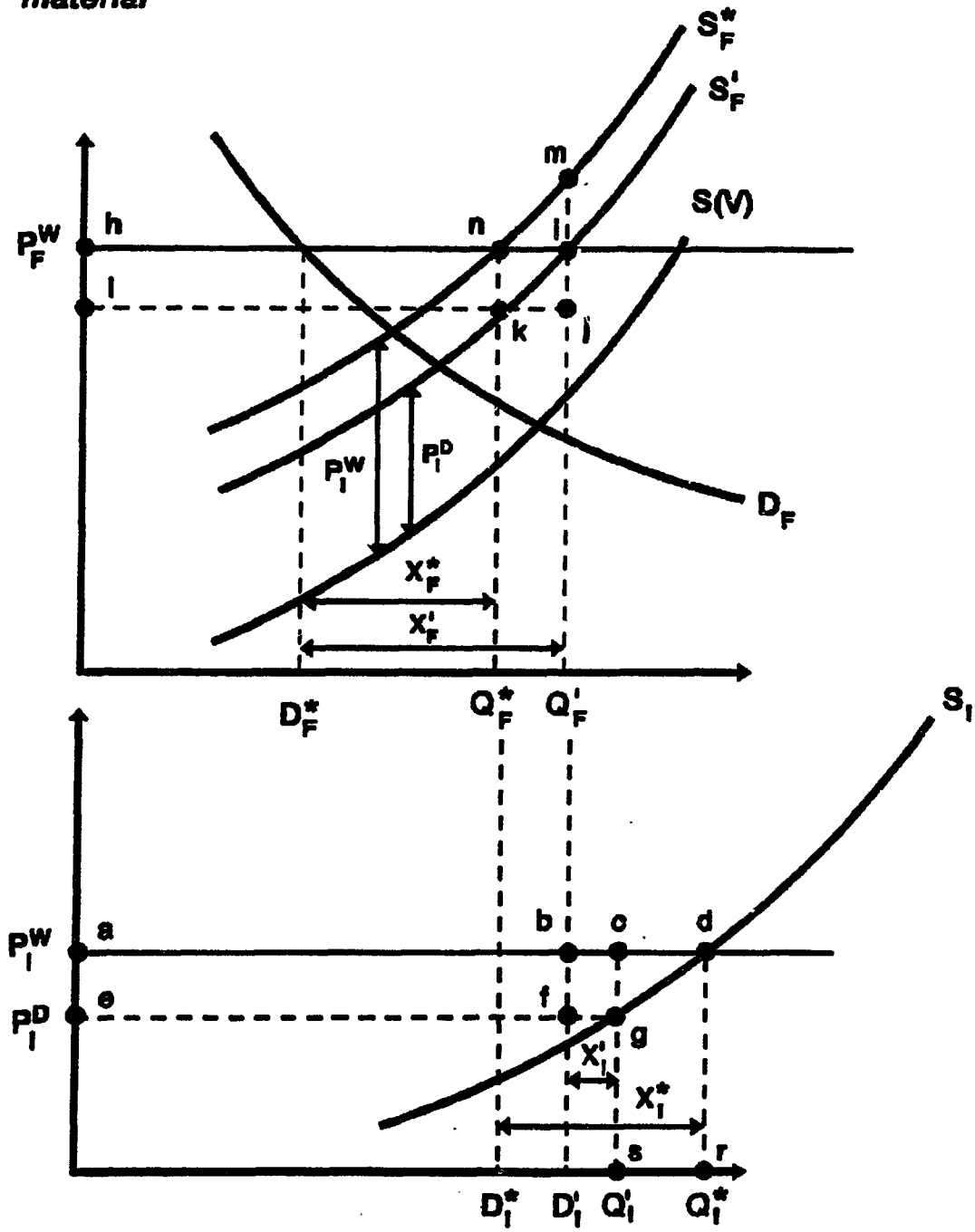


FIGURE 3:
Single processor, free trade

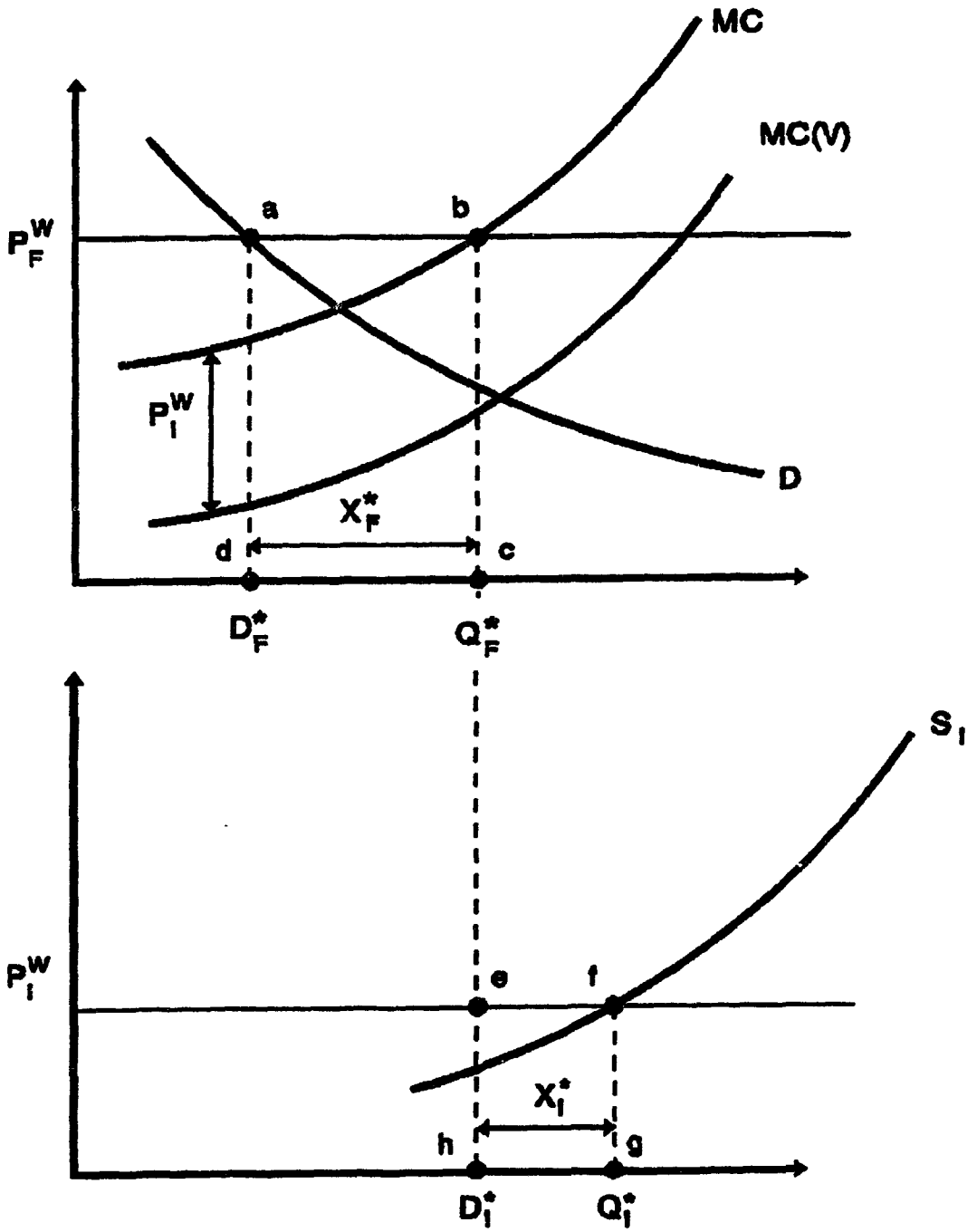
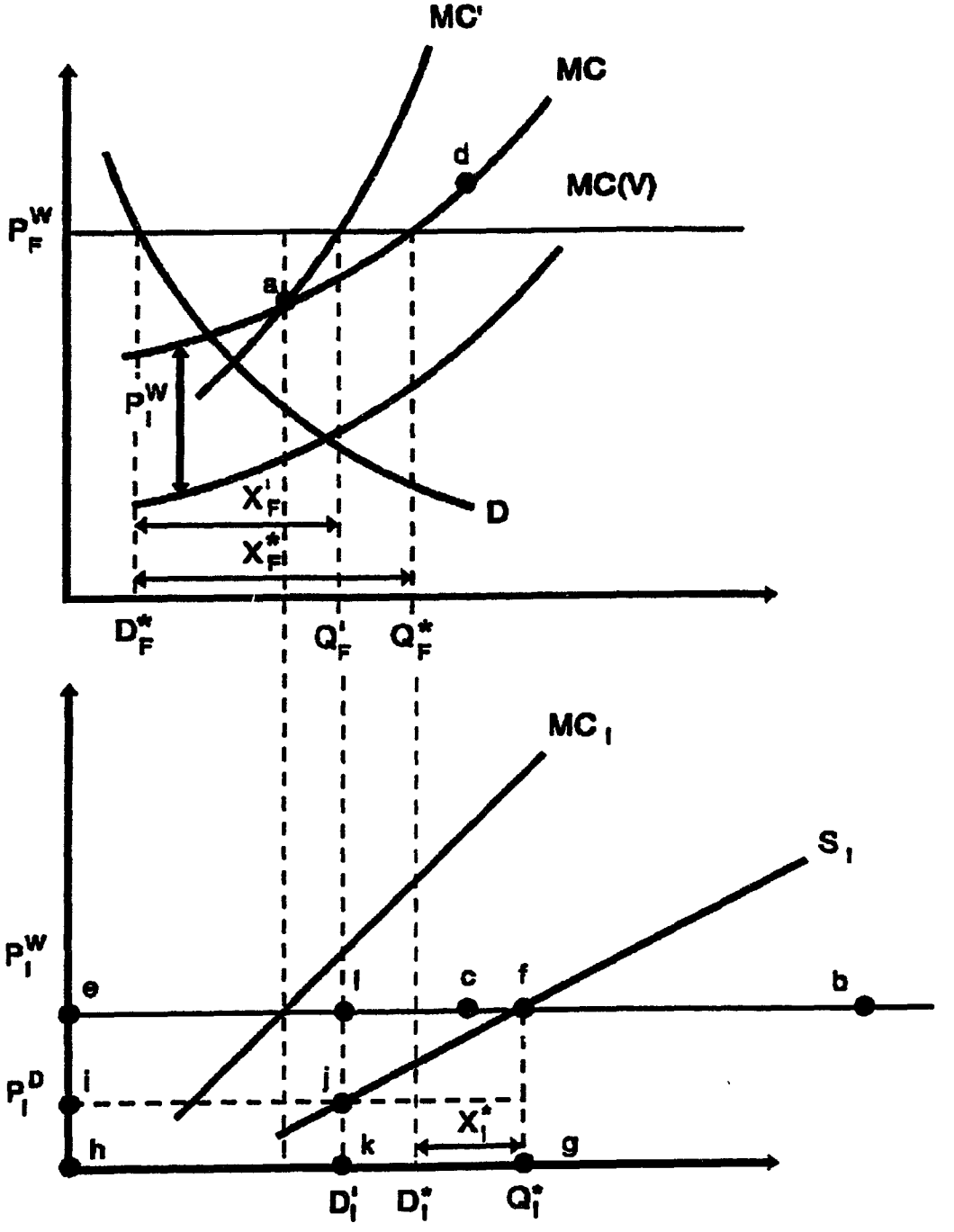


FIGURE 4:
Single processor, export control on raw material input



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